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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/941,123	08/28/2001	Gurtej Singh Sandhu	303.676US3	6644

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EXAMINER	
MONDT, JOHANNES P	
ART UNIT	PAPER NUMBER
2826	

DATE MAILED: 11/19/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/941,123	SANDHU ET AL.	
	Examiner	Art Unit	
	Johannes P Mondt	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspond nce address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11 August 2003*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *46-47 and 57-82* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *46,47 and 60-82* is/are allowed.

6)☒ Claim(s) *57-59* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. §§ 119 and 120

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

13)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application) since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

a) ☐ The translation of the foreign language provisional application has been received.

14)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121 since a specific reference was included in the first sentence of the specification or in an Application Data Sheet. 37 CFR 1.78.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *8/11/3* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Information Disclosure Statement

The examiner has considered the item listed in the Information Disclosure Statement filed 8/11/2003. Please see signed copy of Form PTO-1449 enclosed with this official action.

Response to Amendment

Amendment filed 8/11/2003 forms the basis of this official action. In said Amendment Applicants substantially amended claim 57. Applicants previously canceled claims 1-45 and 48-56. Therefore, claims 46, 47 and 57-82 are pending, none of which being withdrawn. For comments on Remarks in said Amendment see below under "Response to Arguments".

Response to Arguments

1. Applicants' arguments, see Remarks, filed 8/11/2003, with respect to the Double Patenting Rejection, have been fully considered and are persuasive. The double-patenting rejection of claims 58-59 has been withdrawn.

2. However, Applicants' arguments filed 8/11/2003, see Remarks filed 8/11/2003, with respect to the rejection under 35 U.S.C. 103(a) of claim 57 have been fully considered but they are not persuasive. In particular, based on the original disclosure the amendment of claim 57 has introduced new matter. In particular, nowhere in the original Specification including claim language in original form is the subject matter of 57, i.e., a memory device comprising memory array, control circuit, I/O circuit as claimed in claim 57 with, as newly amended, an exposed *crystalline* silicon base layer,

disclosed. Furthermore, exposed base layer 904 in Xing et al *is* crystalline (cf. col. 10, l. 4) while Applicants' traverse on the basis that silicide layer 906 is "not directly coupled to said exposed base layer" is not required by the current language of the claim: instead the claim language of claim 57 requires the titanium silicide layer (906) to be directly coupled to the titanium alloy layer (908), which is in evidence (cf. Figures 9 and cited portions). In addition to the inevitable rejection under 35 U.S.C. 112, first paragraph, a rejection under U.S.C. 103(a) over Xing et al in view of Ikeda et al modified only to address the amendment must therefore be provided.

3. Finally, Applicants' arguments, see Remarks, filed 8/11/2003, with respect to the rejection under 35 U.S.C. 103(a) of claims 58-59 have been fully considered but are not persuasive. In particular, it is respectfully submitted that in the cited portion of Xu et al it is discussed that the titanium alloy (Ti-Al) layer (156 in Figure 8, 334 in Figure 17) is formed overlying walls and an exposed base layer of a contact hole. In light of the specific formulation of this traverse it should perhaps be mentioned that the examiner takes the position that "exposed" does not necessarily mean "in contact with" any particular material entity in the structure of the claimed device. Said "walls of the contact hole" are any of the walls of said contact hole, irregardless of orientation, although it is clear that any further specification of the said orientation would not exclude Xu et al as prior art, because 334 (156 in Fig. 8) overlies all walls as well as an exposed base layer of said contact hole. Also, with respect to the traverse on page 11 of said Remarks that appears to be directed to both claims 58 and 59, layer 160 is NOT the only layer forming walls of said contact hole: see cited portions of Xu et al, and Figure 8, from

which it is clear that 150 is a triplex structure consisting of 160 (Ti), 162 (TiN) and 164 (TiN_x). Therefore, it may be said that Xu et al teach a titanium alloy layer overlying walls and an exposed base layer of a contact hole. Based on the above considerations the rejection of claims 58-59 under 35 U.S.C. 103(a) as being unpatentable over Ikeda et al (5,239,196) in view of Xu et al (6,217,721 B1) regretfully must be made to stand as is.

Claim Rejections - 35 USC § 112

4. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. ***Claim 57*** is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim contains subject matter not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. In particular, in its currently amended form claim 57 fails to be supported by the Specification because said exposed silicon base layer of the contact hole is not explicitly disclosed to be crystalline.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

1. ***Claim 57*** is rejected under 35 U.S.C. 103(a) as being unpatentable over Xing et al (6,153,490) in view of Ikeda et al (5,239,196). Xing et al teach (cf. Figures 8 and 9) a memory array (cf. col. 7, l. 9-10) within an integrated memory circuit (cf. title and abstract) comprising:

a contact having a titanium alloy layer 908 (cf. col. 10, l. 5) formed overlying walls of a contact hole 904/906/908 (cf. col. 9, l. 50-col. 10, l. 6) and a titanium silicide layer 906 (cf. col. 9, l. 59) formed overlying an exposed *crystalline* silicon base layer 904 (cf. col. 10, l. 4) of the contact hole (the space of the contact hole is taken up by 904/906/908), the titanium silicide layer 906 being directly coupled to the titanium alloy layer 908, and having a composition that is different from (that of the) titanium alloy layer by virtue of its composition (titanium alloy comprising aluminum).

Xing et al do not necessarily teach the further limitation that said integrated memory circuit comprises a memory device not only comprising the said memory array, but also a control circuit operatively coupled to the memory array and an I/O circuit operatively coupled to the memory array. However, as shown by Ikeda et al, the integration into a memory device of a memory array (MAY; cf. Figure 2) with a control circuit CC operatively coupled to the memory array MB (said operative coupling is standard if not inherent for any useful control circuit to function) (cf. Figure 2 and column 29, lines 2-3) and an I/O circuit (cf. Figures 6 and 7), operatively coupled to the memory array (said operative

coupling is standard if not inherent for any input to get into the memory array or output to be retrieved from it) (cf. column 60, lines 49-59), merely signifies an obvious application of said memory array. In order to exploit a memory array one has to integrate it with a control circuit for controlling the gate voltage, and exchange data with the memory array through input from and output to the outside, whence the I/O circuit of Ikeda et al.

Motivation to include said teaching by Ikeda et al into the invention by Xing et al is therefore merely the exploitation of the standard manner in which a memory array is exploited within integrated memory circuitry. *Combination* of said teaching with said invention is straightforward as the connections to and from, and the embedding of said memory array into, the remaining circuitry does not depend on the specifics of the memory array. *Success* of the implementation of said combination can therefore be assured (and a failure to exploit said memory array at least with standard technology is otherwise almost guaranteed).

7. ***Claims 58-59*** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ikeda et al (5,239,196), in view of Xu et al (6,217,721 B1). Ikeda et al teach a memory device, comprising

a memory array MAY (cf. Figure 2 and column 28, lines 60-62);

a control circuit CC operatively coupled to the memory array MB (said operative coupling is inherent for any control circuit to function) (cf. Figure 2 and column 29, lines 2-3); and

an I/O circuit (cf. Figures 6 and 7), operatively coupled to the memory array (said operative coupling is inherent for any input to get into the memory array or output to be retrieved from it) (cf. column 60, lines 49-59);

wherein at least one of the memory array, control circuit and I/O circuit comprises a contact opening or via or contact having a titanium alloy layer formed in a contact hole and a fill coupled to the titanium comprising layer. Ikeda et al do not necessarily teach said titanium comprising layer to be a titanium alloy layer nor said fill to be formed of aluminum. However, because Xu et al teach that no separate siliciding step is required for inter-level vias, provided one chooses to use aluminum for the fill 334 (cf. column 26, lines 27-28), requiring only modest heating to about 400 degrees centigrade (cf. column 26, lines 9-11), it would have been obvious to one of ordinary skills in the art to modify the invention at the time it was made so as to include the abovementioned extraneous limitations. Moreover, as shown by Xu et al it is especially advantageous in the case of high aspect ratio contact holes to fill them with aluminum (cf. column 10, lines 4-18) that subsequently forms a high-conductivity alloy (titanium-aluminum) (cf. column 26, lines 9-11) with the titanium material of a liner of the walls (except the silicided bottom) for the purpose of increasing the electrical conductivity (cf. column 10, lines 10-32) for reduced response time. Because response time it essential to the operational quality of memory devices *motivation* is established. Because the teaching of Xu et al only would require a different filling of the same contact hole the inventions are *combinable*. Because the aluminum sputtering process (cf. abstract, line 1) taught by Xu et al is especially designed for present-day high-aspect-ratio devices and is independent of all other steps

in the making of the device as taught by Ikeda et al, *success* in combining the inventions can be reasonably expected.

With regard to claim 59, the method used for producing the titanium alloy layer is irrelevant to the present device type invention as long as the claimed aspects are found in the final structure of the prior art (*claim 59*).

Allowable Subject Matter

2. ***Claims 46-47 and 60-82*** are allowed:

Within the context of especially claim 46, the previously added limitation that the contact be directly coupled to the layer of titanium alloy while the titanium alloy layer and titanium silicide layer must have different compositions (final lines of all independent claims in the above set of claims) is not taught by the cited art, nor rendered obvious through combination of the teachings of the cited art; nor did an update in the search yield prior art in this regard.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

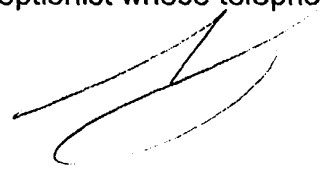
A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within

TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Johannes P Mondt whose telephone number is 703-306-0531. The examiner can normally be reached on 8:00 - 18:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J Flynn can be reached on 703-308-6601. The fax phone number for the organization where this application or proceeding is assigned is 703-308-7722.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



JPM
November 11, 2003